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Extensions to RSVP-TE for P2MP LSP Egress Local Protection
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Abstract

This document describes extensions to Resource Reservation Protocol - Traffic Engineering (RSVP-TE) for locally protecting egress nodes of Traffic Engineered (TE) point-to-multipoint (P2MP) Label Switched Paths (LSPs) in Multi-Protocol Label Switching (MPLS) and Generalized MPLS (GMPLS) networks.

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Table of Contents

1. Introduction

"Fast Reroute Extensions to RSVP-TE for LSP Tunnels" RFC 4090 describes two methods for protecting P2P LSP tunnels or paths at local repair points. For a P2P LSP, the local repair points are the intermediate nodes between the ingress node and the egress node of the P2P LSP. The first method is a one-to-one protection method, where a detour backup P2P LSP for each protected P2P LSP is created at each potential point of local repair. The second method is a facility bypass backup protection method, where a bypass backup P2P LSP tunnel is created using MPLS label stacking to protect a potential failure point for a set of P2P LSP tunnels. The bypass backup tunnel can protect a set of P2P LSPs that have similar backup constraints.

"Extensions to RSVP-TE for P2MP TE LSPs" RFC 4875 describes how to use the one-to-one protection method and facility bypass backup protection method to protect a link or intermediate node failure on the path of a P2MP LSP. However, there is no mention of locally protecting an egress node failure in a protected P2MP LSP.

This document defines extensions to RSVP-TE for locally protecting an egress node of a Traffic Engineered (TE) point-to-multipoint (P2MP) Label Switched Path through using a backup P2MP sub LSP.

2. Terminology

This document uses terminologies defined in RFC 2205, RFC 3031, RFC 3209, RFC 3473, RFC 4090, RFC 4461, and RFC 4875.

3. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119.

4. Mechanism

This section briefly describes a solution that locally protects an egress node of a P2MP LSP through using a backup P2MP sub LSP. For an egress node of a P2MP LSP, a backup egress node is designated to protect the egress node. The previous-hop node of the egress node of the P2MP LSP sets up a backup P2MP sub LSP from itself to the backup egress node after receiving the information about the backup egress node.

The previous-hop node sets up the backup P2MP sub LSP, creates and maintains its state in the same way as setting up a P2MP S2L sub LSP from the signalling's point of view. It constructs and sends a RSVP-TE PATH message along the path for the backup P2MP sub LSP, and receives and processes a RSVP-TE RESV message that responses to the PATH message.

The forwarding state for the backup P2MP sub LSP is different from that for a P2MP S2L sub LSP. After receiving the RSVP-TE RESV message for the backup P2MP sub LSP, the previous-hop node creates a forwarding entry with an inactive state or flag. This forwarding entry with an inactive state or flag is called an inactive forwarding entry. In a normal operation, this inactive forwarding entry is not used to forward any data traffic. However, the forwarding entry for a P2MP S2L sub LSP is with an active state or flag.

When a failure of the egress node happens, the state or flag of the forwarding entry for the backup P2MP sub LSP is set to be active. Thus, on the previous-hop node of the egress node, the data traffic will be forwarded to the backup egress node instead of to the egress node through the backup P2MP sub LSP from the P2MP LSP. From the backup egress node, the data traffic is sent to its destination.

5. Representation of a backup P2MP Sub LSP

A backup P2MP sub LSP exists within the context of a P2MP LSP in a way similar to a P2MP S2L sub LSP. It is identified by the P2MP ID, Tunnel ID, and Extended Tunnel ID in the P2MP SESSION object, the tunnel sender address and LSP ID in the P2MP SENDER_TEMPLATE object, and the backup P2MP sub LSP destination address in the EGRESS_BACKUP_P2MP_SUB_LSP object. The EGRESS_BACKUP_P2MP_SUB_LSP object is defined in the section below.

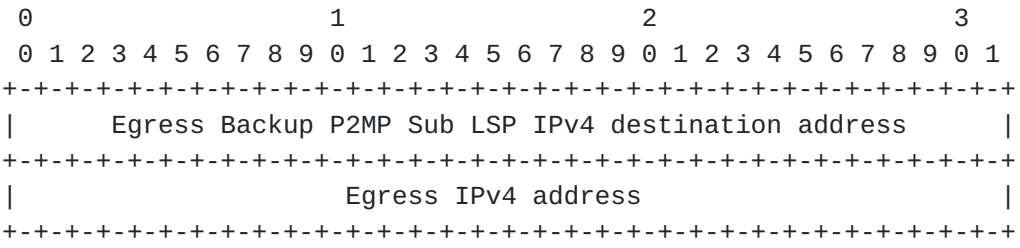
An EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE Object (EB-SERO) is used to optionally specify the explicit route of a backup P2MP sub LSP that is from a previous-hop node to a backup egress node. The EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE object is defined in the following section.

5.1. EGRESS_BACKUP_P2MP_SUB_LSP Object

An EGRESS_BACKUP_P2MP_SUB_LSP object identifies a particular backup P2MP sub LSP belonging to the P2MP LSP.

5.1.1. EGRESS_BACKUP_P2MP_SUB_LSP IPv4 Object

EGRESS_BACKUP_P2MP_SUB_LSP Class = 50,
EGRESS_BACKUP_P2MP_SUB_LSP_IPv4 C-Type = 3

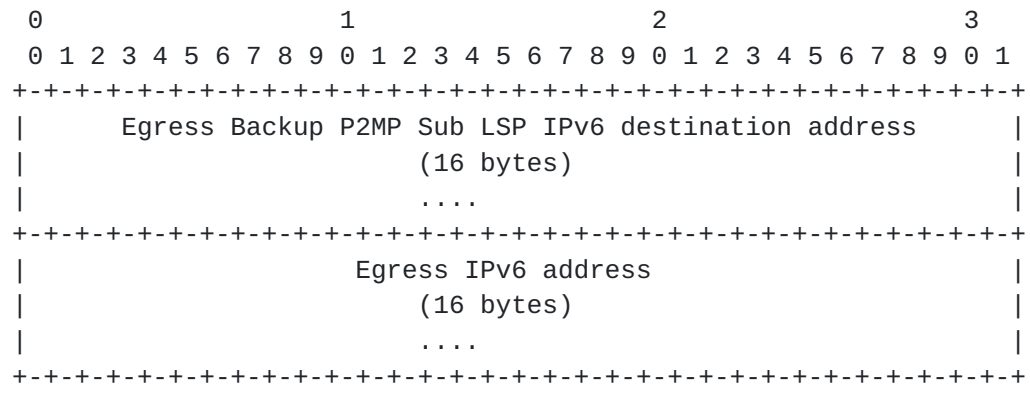


Egress Backup P2MP Sub LSP IPv4 destination address
IPv4 address of the backup P2MP sub LSP destination.
Egress IPv4 address
IPv4 address of the egress node

The class of the EGRESS_BACKUP_P2MP_SUB_LSP IPv4 object is the same as that of the S2L_SUB_LSP IPv4 object defined in RFC 4875. The C-Type of the EGRESS_BACKUP_P2MP_SUB_LSP IPv4 object is a new number 3, or may be another number assigned by Internet Assigned Numbers Authority (IANA).

5.1.2. EGRESS_BACKUP_P2MP_SUB_LSP IPv6 Object

EGRESS_BACKUP_P2MP_SUB_LSP Class = 50,
EGRESS_BACKUP_P2MP_SUB_LSP_IPv6 C-Type = 4



Egress Backup P2MP Sub LSP IPv6 destination address
IPv6 address of the backup P2MP sub LSP destination.
Egress IPv6 address
IPv6 address of the egress node

The class of the EGRESS_BACKUP_P2MP_SUB_LSP IPv6 object is the same as that of the S2L_SUB_LSP IPv6 object defined in RFC 4875. The C-Type of the EGRESS_BACKUP_P2MP_SUB_LSP IPv6 object is a new number 4, or may be another number assigned by Internet Assigned Numbers Authority (IANA).

5.2. EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE Object

The format of an EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE (EB-SERO) object is defined as identical to that of the ERO. The class of the EB-SERO is the same as the SERO defined in RFC 4873. The EB-SERO uses a new C-Type = 3, or may use another number assigned by Internet Assigned Numbers Authority (IANA). The formats of sub-objects in an EB-SERO are identical to those of sub-objects in an ERO defined in RFC 3209.

6. Path Message

This section describes extensions to the Path message defined in RFC 4875. The Path message is enhanced to transport the information about a backup egress node to the previous-hop node of an egress node of a P2MP LSP through including an egress backup P2MP sub LSP descriptor list.

6.1. Format of Path Message

The format of the enhanced Path message is illustrated below.

```
<Path Message> ::=  <Common Header> [ <INTEGRITY> ]
                    [ [<MESSAGE_ID_ACK> | <MESSAGE_ID_NACK>] ...]
                    [ <MESSAGE_ID> ]
                    <SESSION> <RSVP_HOP>
                    <TIME_VALUES>
                    [ <EXPLICIT_ROUTE> ]
                    <LABEL_REQUEST>
                    [ <PROTECTION> ]
                    [ <LABEL_SET> ... ]
                    [ <SESSION_ATTRIBUTE> ]
                    [ <NOTIFY_REQUEST> ]
                    [ <ADMIN_STATUS> ]
                    [ <POLICY_DATA> ... ]
                    <sender descriptor>
                    [<S2L sub-LSP descriptor list>]
                    [<egress backup P2MP sub LSP descriptor list>]
```

The format of the egress backup P2MP sub LSP descriptor list in the enhanced Path message is defined as follows.

```
<egress backup P2MP sub LSP descriptor list> ::=
                    <egress backup P2MP sub LSP descriptor>
                    [ <egress backup P2MP sub LSP descriptor list> ]

<egress backup P2MP sub LSP descriptor> ::=
                    <EGRESS_BACKUP_P2MP_SUB_LSP>
                    [ <EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE> ]
```

6.2. Processing of Path Message

The ingress node of a P2MP LSP initiates a Path message with an egress backup P2MP sub LSP descriptor list for protecting egress nodes of the P2MP LSP. In order to protect an egress node of the P2MP LSP, the ingress node MUST add an EGRESS_BACKUP_P2MP_SUB_LSP object into the Path message. The object contains the information about the backup egress node to be used to protect the failure of the egress node. An EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE object, which describes an explicit path to the backup egress node, SHOULD follow the EGRESS_BACKUP_P2MP_SUB_LSP.

After an intermediate node (a transit or branch node) receives the

Path message with an egress backup P2MP sub LSP descriptor list, for each EGRESS_BACKUP_P2MP_SUB_LSP containing a backup egress node in the list, the intermediate node of the P2MP LSP MUST put the EGRESS_BACKUP_P2MP_SUB_LSP with the directly following EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE into the Path message that is to be sent toward the direction to the previous-hop node of the egress node that is to be protected by the backup egress node if the intermediate node is not the previous-hop node of the egress node.

If the intermediate node is the previous-hop node of an egress node, when it receives the Path message with the EGRESS_BACKUP_P2MP_SUB_LSP containing the backup egress node to be assigned for protecting the egress node, the intermediate node generates a new Path message based on the information in the EGRESS_BACKUP_P2MP_SUB_LSP and the possible directly following EGRESS_BACKUP_P2MP_SECONDARY_EXPLICIT_ROUTE. The format of this new Path message is the same as that of the Path message defined in RFC 4875. This new Path message is used to signal the segment of a special S2L sub-LSP of the P2MP LSP from the previous-hop node to the backup egress node. The new Path message is sent to the next-hop node along the path for the backup P2MP sub LSP.

When an egress node of the P2MP LSP receives the Path message with an egress backup P2MP sub LSP descriptor list, it SHOULD ignore the egress backup P2MP sub LSP descriptor list and generate a PathErr message.

7. IANA Considerations

TBD

8. Acknowledgement

The author would like to thank Quintin Zhao for his valuable comments on this draft.

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9.2. Informative References

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